Chapter Four

Linear and exponential equations

Linear equations:

- In a simplified manner, a linear equation can be said to be an equation, in which none of the letters or number has been raised to any power.
- On the other hand in an exponential equation, one of the letters or numbers has been raised to a power or an exponent.

Linear equation

- A linear equation such as $2x + 1 = -x + 1$ can also be written as $+2x + 1 = -x + 1$. - The equation $4x + 3 = 2x - 1$, can also be written as $+4x + 3 = +2x - 1$.
- Lastly the equation $5 + 2x = 8 - x$, can be written as $+5 + 2x = +8 - x$.
- In short if there is no negative sign in front of a letter or a number, then the sign in front of it is taken to be the positive sign.
- The sign before a number or a letter is also part of that letter or number.
- For example consider the equation $2x - 5 = -4 + x + 2$, the negative sign before the 5 is part of the 5, the positive sign before the $2x$ forms part of the $2x$, the $-$ sign before the $4x$ also forms the part of it, and the positive sign before the 2 forms part of it.   - When a number or a letters crosses the equal to sign i.e $=$, then the initial sign before that number or letter must be changed into the opposite sign.
- For example if the sign before the letter or number is the positive sign, then it changes into the negative sign, after crossing the equal to sign.

Q1. Given that $x + 1 = 6$, find x.

<center>Soln.</center>

Since $x + 1 = 6 => x = 6 - 1 = 5, => x = 5$.

Q2. If $2x - 4 = 6$, $find\ x$

<div align="center">Soln.</div>

Since $2x - 4 = 6, => 2x = 6 + 4, => 2x = 10.$

Divide through using $2 => \frac{2x}{2} = \frac{10}{2} => x = 5.$

Q3. Given that $5x = x - 8$, calculate the value of x.

<div align="center">Soln.</div>

Since $5x = x - 8, => 5x - x = -8, => 4x = -8.$

Dividing through using $4 => \frac{4x}{4} = \frac{-8}{4} => x = -2.$

Q4. Determine the value of n, given that 6n + 2 = 3n + 14.

<div align="center">Soln.</div>

Since $6n + 2 = 3n + 14, => 6n + 2 - 3n = 14, => 6n - 3n + 2 = 14, =>$
$6n - 3n = 14 - 2, => 3n = 12 \Longrightarrow n = 4.$

Q5. If $4x + 5 = 17 + 2x, \ find \ x.$

<div align="center">Soln.</div>

$Since \ 4x + 5 = 17 + 2x, \Longrightarrow 4x + 5 - 2x = 17, \Longrightarrow 4x - 2x = 17 - 5, \Longrightarrow 2x =$
$12, \Longrightarrow \frac{2x}{2} = \frac{12}{2} \Longrightarrow x = 6.$

Q6. If $6x - 1 = -2x + 15$, determine the value of x.

<div align="center">Soln.</div>

Since $6x - 1 = -2x + 15, => 6x - 1 + 2x = 15, \Longrightarrow 6x + 2x - 1 = 15, \Longrightarrow 6x +$
$2x = 15 + 1, \Longrightarrow 8x = 16 \Longrightarrow \frac{8x}{8} = \frac{16}{8} \Longrightarrow x = 2.$

Q7. If $4y + 10 = 2 + 3y, find \ y.$

<div align="center">Soln.</div>

$Since \ 4y + 10 = 2 + 3y, => 4y + 10 - 3y = 2, \Longrightarrow 4y - 3y + 10 = 2 \Longrightarrow 4y - 3y =$
$2 - 10, \Longrightarrow y = -8.$

Q8. Determine the value of y, given that 7y – 2 – 3y = -5y + 16.

<div align="center">Soln.</div>

Since $7y - 2 - 3y = -5y + 16, => 7y - 3y - 2 = -5y + 16, \Longrightarrow 4y - 2 = -5y + 16, \Longrightarrow 4y - 2 + 5y = 16, \Longrightarrow 4y + 5y - 2 = 16, \Longrightarrow 9y - 2 = 16, \Longrightarrow 9y = 16 + 2 = 18, => y = \frac{18}{9} \Longrightarrow y = 2.$

Q9. If $-2x - 8 + 5x = 16 - 4x - 3, solve\ for\ x.$

<div align="center">Soln.</div>

$Since - 2x - 8 + 5x = 16 - 4x - 3, => -2x + 5x - 8 = 16 - 3 - 4x, => 3x - 8 = 13 - 4x, \Longrightarrow 3x - 8 + 4x = 13, \Longrightarrow 3x + 4x - 8 = 13, => 7x - 8 = 13, \Longrightarrow 7x = 13 + 8 = 21, \Longrightarrow x = \frac{21}{7} = 3.$

Q10. If $3x - 1 + 2x = 4x + 6 + 2,$ determine the value of $x.$

<div align="center">Soln.</div>

$Since\ 3x - 1 + 2x = 4x + 6 + 2, => 3x + 2x - 1 = 4x + 8, \Longrightarrow 5x - 1 = 4x + 8,$
$\Longrightarrow 5x - 1 - 4x = 8, \Longrightarrow 5x - 4x - 1 = 8, \Longrightarrow x - 1 = 8, \Longrightarrow x = 8 + 1$
$= 9.$

Q11. If $3y - 3 - 6y = -12,$ find the value of y.

<div align="center">Soln.</div>

$Since\ 3y - 3 - 6y = -12, => 3y - 6y - 3 = -12, \Longrightarrow -3y - 3 = -12, \Longrightarrow -3y$
$= -12 + 3, \Longrightarrow -3y = -9.$

Divide through using -3, $i.e\ \frac{-3y}{-3} = \frac{-9}{-3} \Longrightarrow y = 3.$

Q12. Solve for n, given that $2n + 4 - 6n = -8 + 2n.$

<div align="center">Soln.</div>

$Since\ 2n + 4 - 6n = -8 + 2n, \Longrightarrow 2n - 6n + 4 = -.8 + 2n, \Longrightarrow -4n + 4 = -8 + 2n, \Longrightarrow -4n + 4 - 2n = -8, \Longrightarrow -4n - 2n + 4 = -8, \Longrightarrow -6n + 4 = -8, \Longrightarrow -6n = -8 - 4, \Longrightarrow -.6n = -12.$

Divide through using -.6 $\Longrightarrow \frac{-.6n}{-.6} = \frac{-12}{-6} \Longrightarrow n = 2.$

Linear equations associated with cross multiplication:

- Certain linear equations may be given in the disguised form and will really only show themselves up, only after the application of cross multiplication.

- In multiplication, when there is the positive or the negative sign between a number and a letter, or between two letters, we must put them into the bracket.

- Example (1)

Multiply a – 2 by 4.

<div align="center">Soln.</div>

$(a - 2) \times 4 = 4(a - 2) = 4a - 8.$